PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements in or relating to Dynamo-Electric Machines

I, FRANCIS JAMES ALLEN, a British Subject, of "Angle House," Burley Lane, Quarndon, Derbyshire, do hereby declare the nature of this invention to be as follows:—

This invention relates to dynamo-electric machines and has for its object to provide an improved construction and arrangement thereof.

According to this invention, the stator-laminations are assembled in groups extending radially from the rotor, and the armature-winding is accommodated in the radially divergent gaps between the said groups. Preferably the stator-laminations are so disposed as to provide at their radially inner ends a continuous or toothless face to the rotating poles.

In one preferred construction the stator-laminations are of **U**-shape with the limbs of the **U** disposed radially inwards towards the pole-faces.

According to another feature of the invention the rotor is formed with two sets of radial poles spaced apart axially, and each pole of one set is aligned axially with a co-operating pole of the other set. In one such construction the poles of one set are all of the same polarity and the poles of the other set are all of the opposite polarity giving a homopolar machine; in an alternative construction the poles of each set are alternately of opposite polarities, and each pole of a set is aligned axially with a pole of the other set which is of opposite polarity to itself, giving a heteropolar machine.

In a homopolar machine according to this invention the rotor may be of solid construction and is formed at each end with radially projecting poles providing outwardly directed pole-faces. The rotor is preferably magnetized axially by means of a stationary exciting coil housed within arched portions of the armature-stampings around the middle section of the rotor. All the poles at one end of the rotor are of the same polarity and the poles at the other end of opposite polarity and each pole at one end is aligned axially with the complementary pole at the other end.

The stator comprises a suitable frame in which the laminations are mounted, and these laminations are of arch or **U**-shape disposed axially of the rotor so that the ends of each limb of the **U**-shape are aligned with the pole - faces at the two ends of the rotor. Since the limbs of the **U**-shape laminations extend radially from the axis of the rotor, they diverge along their length from the axis, and they are therefore assembled in packs or groups, the packs lying radially to the rotor with their radially inner ends touching one another so as to provide a continuous or toothless face adjacent to the rotating pole-faces on the rotor. The armature - windings are disposed in the gaps between the packs of laminations towards the radially outer end thereof, adequate space being available because these gaps are divergent. Any desired form of armature-winding may be used.

This construction of homopolar machine is particularly suitable for operation at the highest possible speeds, and since the construction provides a toothless form of armature and rotor, it permits the use of a solid rotor capable of high speeds without loss of efficiency. Adequate ventilation is readily provided by the divergent gaps in the stator, rendering a high duty possible.

Such machines are particularly applicable for operation at high speeds as either motors or generators and they may therefore be used for such purposes as a high speed dynamometer for testing turbines, without using a reduction gear.

In one form of heteropolar machine according to this invention, a set of poles is provided at each end of the rotor excited by field-windings so as to provide, in each set of poles, alternate North and South poles, but the axial alignment at

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the two ends is such that the poles which are axially aligned are respectively North and South. In such a machine there is a reversal of flux in the armature so that the machine becomes a full-duty type instead of a half-duty type as in the case of a homopolar generator, so that a greater output is obtained at whatever speed the machine may be operated.

A special feature of this arrangement is that there is no necessity for the rotor to provide a magnetic path throughout its length, since the flux path is from a North pole at one end of the rotor through the armature to the South pole at the other end of the rotor thence circumferentially at that end of the rotor to the adjacent North poles and from these poles back by the armature laminations to the corresponding South poles at the first end of the rotor, and circumferentially at that end of the rotor to the first mentioned North pole. The leakage between adjacent poles at each end of the rotor would be negligibly small.

A heteropolar machine of this type is very similar to a pair of machines of normal construction, but it offers the advantage of using a slotless winding which leads to absence of tooth losses, maximum iron sections, ample accommodation for copper, smooth wave-form, and easy ventilation.

In an alternative construction of heteropolar machine similar advantages are obtained in a machine having a single set of poles constituting the rotor. The rotor is of normal heteropolar type carrying its exciting windings. The stator or armature core comprises groups or packs of essentially rectangular iron laminations assembled radially around the rotor in a suitable frame and lying substantially in planes containing the axis of the machine. The inner edges preferably touch one another to form an unbroken toothless tunnel around the rotor, and the outer edges register preferably in grooves with a ring of laminations lying in the plane of rotation. The packs or groups of iron laminations diverging at their outer radius provide gaps for accommodating windings; the external ring laminations constitute a circumferential continuity of magnetic path between the poles. The windings will thus be of an orthodox type but lying substantially in the wall of a cylinder, being spaced further from the armature-tunnel than normally.

Dated this 12th day of March, 1947.
BOULT, WADE & TENNANT,
111 & 112, Hatton Garden,
London, E.C.1,
Chartered Patent Agents.

COMPLETE SPECIFICATION

Improvements in or relating to Dynamo-Electric Machines

I, FRANCIS JAMES ALLEN, a British Subject, of "Angle House," Burley Lane, Quarndon, Derbyshire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to dynamo-electric machines and has for its object to provide an improved construction and arrangement thereof.

According to this invention there is provided a synchronous alternating-current dynamo-electric machine comprising a rotor having two sets of axially spaced pole formations, the pole formations of each set being magnetized or magnetizable to provide radially outward facing pole faces of which adjacent poles are complementary, and a stator to provide flux paths between axially spaced complementary poles of the two sets comprising **U**-shaped laminations extending axially of the rotor and assembled in packs with the radially inner ends of the limbs of the laminations forming rotor tunnels which are peripherally substantially continuous and within which said sets of pole formations rotate, two such packs of laminations forming with the associated pole formations a complete flux circuit in which the flux varies cyclically on rotation of the rotor, and further comprising armature windings on said packs threaded by the flux circuit and encircling the limbs and/or base portions of the **U**-shaped laminations, being accommodated in the divergent spaces between the packs and in the internal annular space formed by the **U**-shaped laminations and passing over the external surfaces of said laminations.

According to another feature of the invention each pole of one set of the axially spaced poles may be aligned axially with a complementary pole at the other end of the rotor and one lamination in each pack is substantially co-planar with the axis of the rotor.

A preferred arrangement of dynamo-electric machine will now be described by way of example of this invention, reference being made in the description

to the accompanying drawing which illustrates the machine in perspective diagrammatic view.

The synchronous alternating current dynamo-electric machine illustrated in the drawing comprises a rotor 20 which is provided at each end with a set of poles 21, 22 magnetized so that in each set the poles are alternately North and South poles, i.e., so that adjacent poles are complementary. The poles may be permanently magnetized or alternatively they may carry field windings excited through slip rings from a suitable supply. The poles of each set are aligned axially so that a North pole of one set is aligned with a South pole of the other set.

The stator structure is constructed from packs 23 of **U**-shaped laminations (of which two only are shown for clarity) disposed around the rotor in planes substantially containing the rotor axis so that the radially inner ends of the limbs of the laminations are close together to form a toothless rotor tunnel. Armature windings 24 are accommodated in the divergent gaps between the packs around the bases of the **U**-shaped laminations as indicated in full lines. This arrangement is preferred although in certain cases the windings may, as indicated in dotted lines, be located around the radially outer ends of the limbs.

A special feature of this arrangement is that there is no necessity for the rotor to provide a magnetic path throughout its length, since the complete flux circuit, indicated by chain line 25 is from North pole 21 at one end of the rotor through the armature 23 to the South pole 22 at the other end of the rotor thence circumferentially at that end of the rotor to the adjacent North poles 22 and from these poles back by the armature laminations 23 to the corresponding South poles 21 at the first end of the rotor, and circumferentially at that end of the rotor to the first mentioned North pole 21, so that the flux path through one pack is completed axially through another pack. The leakage between adjacent poles at each end of the rotor would be negligibly small so that no bearing demagnetizing coils are required.

A heteropolar machine of this type offers the advantage of using a slotless winding which leads to absence of tooth losses maximum iron sections, ample accommodation for copper, smooth waveform and easy ventilation.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A synchronous alternating current dynamo-electric machine comprising a rotor having two sets of axially spaced pole formations, the pole formations of each set being magnetized or magnetizable to provide radially outward facing pole faces of which adjacent poles are complementary, and a stator to provide flux paths between axially spaced complementary poles of the two sets comprising **U**-shaped laminations extending axially of the rotor and assembled in packs with the radially inner ends of the limbs of the laminations forming rotor tunnels which are peripherally substantially continuous and within which said sets of pole formations rotate, two such packs of laminations forming with the associated pole formations a complete flux circuit in which the flux varies cyclically on rotation of the rotor, and further comprising armature windings on said packs threaded by the flux circuit and encircling the limbs and/or base portions of the **U**-shaped laminations, being accommodated in the divergent spaces between the packs and in the internal annular space formed by the **U**-shaped laminations and passing over the external surfaces of said laminations.

2. A synchronous alternating-current dynamo-electric machine as claimed in claim 1, wherein each of the axially-spaced poles is aligned axially with a complementary pole at the opposite end of the rotor, and wherein one lamination in each pack is substantially co-planar with the axis of the rotor.

3. A synchronous alternating-current dynamo-electric machine substantially as hereinbefore described with reference to the accompanying drawing.

Dated this 9th day of April, 1948.
BOULT, WADE & TENNANT,
111 & 112, Hatton Garden,
London, E.C.1,
Chartered Patent Agents.

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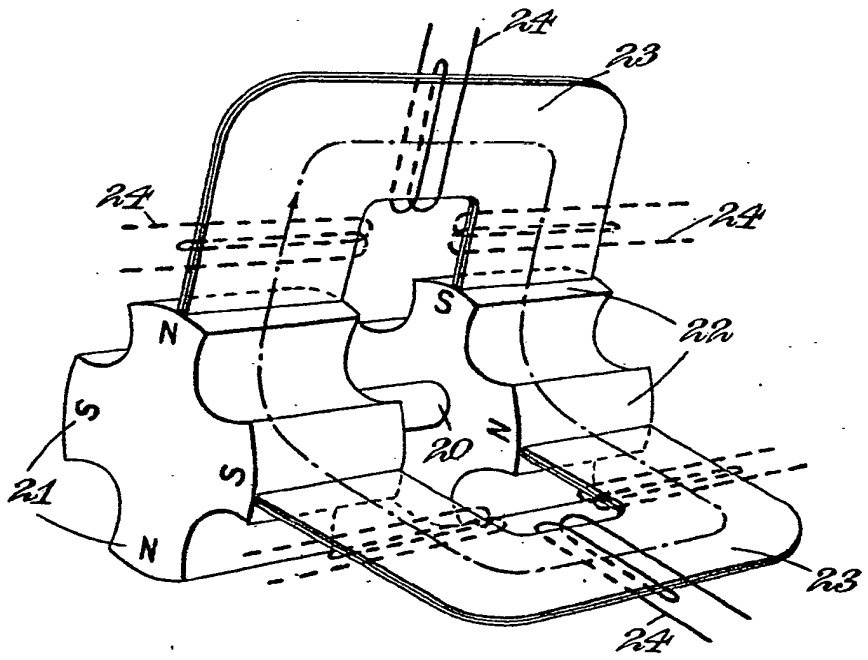
[This Drawing is a reproduction of the Original on a reduced scale.]



H.M.S.O. (Ty.P.)